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Farmers' Cooperative Demonstration Work,

WASHINGTON, D. C.

FIELD INSTRUCTIONS FOR FARMERS' COOPERATIVE DEMONSTRATION WORK IN WESTERN TEXAS AND OKLAHOMA.[1]

INTRODUCTION.

So new is the agriculture of the great Southwest, including western Oklahoma and Texas, that the amount of reliable data on the best agricultural practices for this region is relatively small. We realize that not enough is known to enable anyone to lay down hard and fast rules. In this circular it is intended to make suggestions which will help the average farmer to make production more certain and to eliminate some of the great uncertainties surrounding him. No attempt will be made to outline an entire plan of farming. It is hoped that these suggestions will lead to surer production and more profitable farming. Ultimately experience, observation, and research will develop a reasonably successful agricultural system for this territory.

CLIMATIC CONDITIONS.

These instructions are intended to apply to that portion of the States of Oklahoma and Texas where the average annual rainfall over long periods of years has been 30 inches or less. In determining the area to which this circular is to apply the following facts are to be considered: No definite line can be drawn which marks the separation between humid sections and semiarid sections. That system which is commonly known as "dry farming" applies to the semiarid regions. In humid sections, where the rainfall is greater and more regular, the principal object of systems of farming is to maintain soil fertility, and conservation of moisture is of secondary consideration. But as we go west conservation of moisture becomes of more and more importance. Whenever we reach a territory where the conservation of moisture becomes the primary object of farm practices we may say that we have reached a semiarid section. This

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[1] This circular is prepared from material obtained from various sources. Many helpful suggestions have been made by Mr. W. D. Bentley and Mr. George L. Bishop, State and district agents, respectively, for Oklahoma. Credit for information obtained should also be given to other offices of the Bureau of Plant Industry, the Experiment Station Record, and other sources.

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circular applies to those sections of Oklahoma and Texas where conservation of moisture is of primary and not of secondary importance.

It is not intended to say that the building up of soil fertility, the increase of humus in the soil, and other important farm practices are not important in this region. The relative importance of these practices is changed solely by the climatic conditions.

In Oklahoma this territory may, generally speaking, be said to be west of meridian 98, which is practically the main line of the Rock Island Railroad, north and south. However, the maps of the Weather Bureau tend to show that the line of 30 inches average rainfall cuts pretty close through Oklahoma City. In Texas the eastern border of this territory is quite irregular, but runs approximately from a little east of Wichita Falls, on the north line, south through Austin, curving to the east at its south end about as far as Victoria.

While the average annual rainfall of all this territory runs from 30 down to 15 inches, a large portion of it has a rainfall of between 20 and 30 inches. When the records of any given station are examined it is found that the rainfall has varied from year to year. These variations have been marked. Not infrequently the rainfall of one year is less than half that of the year before and sometimes less than one-third that of a year or so previous. Let us give one example in Texas and one in Oklahoma to show what is meant.

The record of the station at San Angelo, Tom Green County, Tex., shows that the average rainfall from 1872 to 1909 was 22.39, yet in 1883 there was a rainfall of 41.91 inches. In 1884 it fell to 21.10 and in 1885 to only 11.51 inches. In 1906 the rainfall was 31.87 and in 1907 15.28 inches.

While the average annual rainfall in Mangum, Greer County, Okla., was 26 inches prior to 1904, that for 1905 was 36.25; for 1906, 39.92; for 1907, 31.20; and for 1908, 38.34 inches. In 1893 the record shows only 11.39 inches. In 1909 the record is not complete. In 1910 it was only 10.86 inches, or 17.29 inches below normal, as given in the annual summary of the Weather Bureau. In 1911 this rose to nearly normal, but again it is to be noted that the high rainfall of that year was very irregular.

For all the years for which we have records there is an average annual rainfall for Hobart, Kiowa County, Okla., on meridian 99, of 27.5 inches; for Mangum, Greer County, in the same State, 25 miles west of there, the records for 20 years show an average of a little over 26 inches. During the four wet years of 1905–1908 there was an increased rainfall in that territory of 10 inches over the average for 20 years. While apparently there are series of dry years and wet years in all this section, a close examination of the records fails to show any established principle that can be given the farmer.

A close study of the records discloses the fact that about one-third and from that down to less than one-fourth of the average annual precipitation falls during October to February, inclusive. During the period from March 1 to September 30, therefore, we have the larger portion of the annual precipitation. It is likewise noticeable from the records that very often a month of relatively heavy precipitation will be followed by one of relatively light precipitation. Apparently the months of heavier precipitation are apt to be those of the spring and early fall, sometimes extending over into October,

but seldom later than that. Of course, there have been years when the record shows relatively heavy precipitation during winter months, but what we are talking about now is the average—that is, the rule—what the farmers are to expect from year to year. It is apparent that the rainfall of all this region is not only light but very irregular from year to year and from month to month. All of these facts have a very important bearing on the kind of farming to be undertaken, the character of the crops to be grown, and especially upon the farm practices to be pursued in the territory in question.

In all of this region of light and irregular rainfall, moisture is the controlling factor in crop production. This statement should be emphasized and impressed upon every farmer in this great Southwest. Humus and soil fertility, seed selection, and proper methods of farming are all important, but it may safely be said that the one controlling factor in all regions of light rainfall is moisture, either stored in the soil for the use of the plant during the growing season or falling upon a properly prepared soil during that season. Three conclusions follow from a study of the rainfall of this region:

(1) The average rainfall of each locality should be ascertained and taken seriously by the farmer.

(2) No dependence should be placed on the record of one, two, or several years in immediate succession. Records for long periods of time should be studied in order that we may know average conditions.

(3) The rainfall of this section, though irregular and at times exceedingly short, is ample for profitable crop production during most of the seasons, provided (1) that proper farm practices which store the rainfall in the soil when it comes are followed; (2) that crops are used which are adapted to the conditions of the section; and (3) that proper attention is given to the cultivation of the crop during the growing season to prevent the evaporation of moisture.

PREPARATION OF THE SEED BED.

The certainty of crop production in all this section depends upon the success of the farmer in storing sufficient moisture and its retention in the earth until used by the growing crop. The methods of farming that best accomplish this result differ somewhat from those used in the more humid sections, but the fundamental principles involved are the same. To fully store, conserve, and utilize the limited or irregular moisture supply in this region, unusual care is necessary in handling the soil after the crop is produced, in the preparation of the seed bed, and in the cultivation of the crop.

A deep, well-prepared seed bed, filled with humus (decaying vegetable matter), is of even greater importance in the semiarid regions than elsewhere. The preparation must be such as will not only furnish the best feeding ground for the roots of the growing plant, but will also insure the storage and retention of the greatest possible amount of moisture. Deep plowing is an essential part of such preparation, but alone is not usually sufficient. Results obtained both at agricultural experiment stations and by practical farmers prove beyond question that deep plowing pays in regions of light rainfall when done sufficiently early in the fall. Only that portion of the annual precipitation which passes into the ground and is pre-

vented from evaporating can be made use of by the growing crops. Deep plowing increases the storage capacity of the soil and lessens both the run-off and evaporation, the two ways in which moisture is lost. It also admits the air and heat necessary for rendering available the plant food in the soil. Humus or decaying vegetable matter enables the soil to hold more moisture and retain it longer; hence its importance in semiarid soils. An economical method of supplying humus and fertility to the soil is by growing a crop of cowpeas on the land as often as practicable and plowing it under. In regions of light rainfall cowpeas should never be planted between rows of corn or other crops, as is the practice in regions of heavier rainfall. With corn, kafir, and milo crops the yield per acre is not usually decreased by planting alternate rows with cowpeas or peanuts. In this way good crops of grain are obtained and the cowpeas or peanuts may be plowed under for the humus. A change in the relative position of the rows for the succeeding crop is advisable as a short and simple method of crop rotation.

PREVIOUS TREATMENT.

No farmer in the region described in this circular should be without the proper tools for doing his work. Among the most important of these are good plows, a disk harrow, and a smoothing harrow. The disk harrow is one of the most useful tools for this territory. After a crop has been produced on any land on the farm it should be harvested as soon as matured and the crop removed. The safest practice is to double-disk the field immediately, thus placing it in condition to receive and retain the moisture that may fall upon it. This is especially important in the case of small grains. The amount of moisture in the soil will not usually permit the growing of a second crop on the same field the same year in this territory during average years. Results obtained by careful experimenters and by practical farmers show that the tilling or cultivating of the field after a small-grain crop by the disk harrow brings an increased yield during the next crop season as compared with the land on which this practice is not followed. In summer tillage after a small-grain crop the field should be disked or harrowed from time to time after the first double-disking, in order to keep the surface in proper condition for moisture conservation. It should be plowed as recommended later and the plowed surface kept with a sufficient soil mulch to receive and retain all moisture falling upon it. Where crops are allowed to stand on the land after the maturity of the grain or other product, or where weeds and grass are allowed to grow, they are constantly pumping moisture from the soil which should be retained for the use of the next crop. Hence, unless there is some economic reason for permitting the crop to stand after its maturity the practice above indicated should be carefully followed.

TIME TO PLOW.

Plowing, except on sandy loams which drift in windy weather, should always be done in the early fall or early winter, the earlier the better. The disking after the maturity of the crop is important

because it helps to make the plowing easier and better, especially where there is considerable delay between the maturity of the crop and the plowing for the next crop. It is best to take no chances on future rainfall. A careful examination of the records, as already indicated, shows that precipitation during the winter months is relatively light. Often it is light in November, while the months of September and October are more likely to show a relatively heavier rainfall. This emphasizes the importance of early preparation. As soon as possible after the removal of the crop, the land should be put in the very best condition to retain any moisture which may have been left in the ground and to absorb and hold the rainfall that may come before planting time. Whenever possible, therefore, preparation should be made by plowing before the fall season for rains. If one waits until after these rains or until some time in the winter, the deep plowing will not be of so much value. On deep, sandy, drifting soils it is best to wait until spring; then prepare with the lister and plant immediately. When spring plowing is necessary it should be followed at once with a weighted disk and section harrow, as already recommended.

HOW DEEP TO PLOW.

The actual depth of plowing must be determined in each case by the kind of soil and the time the plowing is done. If done at the right time and given proper aftertreatment, it is seldom that the plowing can be too deep. The repacking or resettling of the plowed soil in the bottom of the furrow or subsoil, as well as leaving a good earth mulch on top, is of more importance, however, than depth of plowing, especially when a depth of 6 to 8 inches has been reached. Subsoiling, and especially where it does not pulverize the soil, is seldom, if ever, to be recommended in this territory. In the great majority of cases the plowing done in the past has been too shallow for the best results.

AFTERTREATMENT.

As moisture is the controlling factor, caution is necessary in the preparation of the seed bed to avoid the unnecessary loss of moisture already present in the soil. The object is to obtain a deep and well-pulverized seed bed, firmed after the plow so as to reestablish capillarity. The soil must be left in such condition that moisture in the subsoil can readily rise to within easy reach of the roots of the plants. Where land in semiarid regions is plowed with no aftertreatment, and especially where there is any trash on the surface, contact between the plowed surface and the subsoil is not sufficiently reestablished to enable the water from the subsoil to rise into the seed bed. In regions of abundant rainfall this is not so important, because the rain repacks the soil naturally. In semiarid regions the same thing must be accomplished by mechanical means. This is done by thoroughly pulverizing and packing the subsurface or the bottom of the furrow slice immediately after plowing. If a space of dry loose soil and a layer of undecayed vegetable matter is left at the bottom of the furrow, no moisture will be able to come up from below. The result is that, unless the rain falls frequently in sufficient quantities

on land so prepared, great injury to the crop is sure to follow. A firm seed bed for all crops is essential in regions of light rainfall. It is necessary in order to establish capillarity and also to insure germination.

SUBSURFACE PACKING.

To reestablish the capillarity, some form of subsurface packer must be used immediately following the plow. Subsurface packers of suitable type are perhaps the best tools for the purpose indicated, but the disk harrow, if properly used, will do the same work and is besides a useful tool in many other ways. For use as a subsurface packer the disks should be set almost straight, i. e., given just a slight angle. The disk harrow should be heavily weighted, so that it cuts well into the furrow slice, firming it back to the subsoil. It is not necessary that it cut through the furrow slice. The ground should be gone over twice in this manner. Each half day's plowing, or at most each day's plowing, should be so treated before leaving the field. The object of giving the disk a very slight angle is that it thus performs the double duty of packing and mulching the soil, the slight angle causing it to pulverize the surface. Where it is observed that the disk alone does not leave the surface with a sufficient soil mulch to retain moisture, the disk should be immediately followed with the section harrow, weighted at least by the driver riding on the harrow. When the plowing is finished, the field should be cross-disked, and harrowed if necessary, in the same way. Especially should this be done where a considerable growth of weeds and grass has been plowed under.

Between the time of plowing and the planting season, following each rainfall heavy enough to form a crust, the earth mulch should be restored by going over the land with a 4-horse section harrow, weighted at least by the driver riding on the harrow. Packing the subsurface will give the greatest relative results on soils which have been plowed late and in dry seasons.

PREPARATION WITH THE LISTER.

A good many farmers in western Oklahoma and western Texas speak of the advantages of the use of the lister as soon as possible after the thrashing. It is supposed to do the work of both the disk and the plow at one time—plowing the land, killing the weeds, and holding the moisture. It is claimed that all of the land is never completely disconnected from the subsoil and therefore the capillarity is not entirely disturbed, and that moisture, air, and heat are never entirely interrupted in their work of liberating plant food. The relisting puts the mellowest of the soil in the furrow it fills. The practice has not been observed by experimenters a sufficient length of time to enable us to recommend this use of the lister under all circumstances. Our observation leads us to believe that flat breaking and the subsequent treatment advocated in this circular will bring the best results if consistently followed. It is undeniable, however, that good results are being and have been obtained by the use of the lister. We are not discouraging its use by any farmer where experi-

ence and careful tests lead him to think it best under his conditions. Its use is, in effect, a method of deep preparation.

If the lister is used in preparation for planting, the same good effects will come from early listing that come from early plowing. In running the lister, the point that we are emphasizing in this circular is that it is not so much the kind of an implement that is used in preparing the land for any crop in this western territory, but how thoroughly the work is done, what amount of moisture the farmer is able to store in his subsoil, and how carefully the seed bed has been compacted so as to render the submoisture available during the growing season of the crop.

In using the lister you should have a well-mulched furrow. If the colter is removed, more dirt will fall back in the furrow. It is sometimes better to leave the covering shovels in place, as for planting. This insures a sufficient mulch over the bottom of the furrow. It is just as essential to have an earth mulch over the entire surface of the listed ground as it is when using the disk and harrow after fall breaking. The same cultivation should be given the ground after each rain heavy enough to form a crust. The best effect from harrowing listed ground is usually obtained by running across or diagonally to the ridges. Where listing is done far enough ahead of planting time and rains are favorable it is better to work the ridges down and list again. To do this a disk cultivator may be used or a disk harrow, depending upon what the farmer has or which tool he prefers to work with. Many farmers in the Southwest now have and are using for this purpose a very satisfactory implement known as the 2-row lister cultivator. If the implement used to work down the ridges leaves any bare spaces the harrow should be used immediately over the entire field. Do not list up and down a hillside. Run the furrows at an angle or along the hillside, so as to catch a greater amount of water and prevent run-off. The furrows should not run exactly around the hills, because that will prevent drainage. They should be run so that the water will drain off slowly and not back up and break through the beds. Listing and planting should run east and west, on account of the prevailing winds in this territory, unless the lay of the land makes such direction inadvisable.

Sandy lands.—If you list sandy land early and the weather continues dry and the wind rises, the soil will drift into the furrows. If it continues dry the only thing that can be done is to relist. If rains come the farmer can help and usually stop the drifting entirely by harrowing as soon as possible after the rain ceases. The effect of the harrow on the wet surface has a tendency to puddle it, which will be effective for a while.

Listing for wheat.—If the lister is used to prepare land for wheat following wheat, the grain should be stacked or thrashed as soon as possible after it is harvested. Then list as deep as possible, leaving the furrows well mulched, as indicated above. The first rain after listing, go over the ground with a 2-row lister cultivator or some other tool to pull down the ridges. Follow immediately with the harrow. By using a light harrow of three or four sections and a 4-horse team the ground can be covered rapidly. Where the listing is done for the first time in July and is followed by favorable

rains it is possible to work the first listing down and relist in time to get the seed bed ready for planting. The important point is to make a well-prepared seed bed, which will catch and store moisture in the soil and subsoil, and to see that the seed bed has been resettled so as to reestablish capillarity.

A lister is an excellent tool if properly used. The greatest criticism of its use has been that it enables many farmers to do very rapid and at the same time rather poor work. It has its place in the tillage methods of the West, but will endure only in case the farmer takes more care and makes better preparation with it.

CULTIVATION.

The care necessary in the preparation of soil to bring about the best condition for the storage of moisture should be followed in the cultivation during the growing period of the crop to prevent its waste through evaporation. A loose soil with granular texture has low capillary power and will absorb but little water from the moist soil in contact with it. A layer of such loose soil covering the moist soil below will conserve the water in the latter by diminishing the evaporation from it. It is well established by the experience of farmers as well as by direct experiments that a layer of loose dry soil 3 or 4 inches deep is effective in preventing the excessive drying of soils.

The amount of water used by the plant is not uniform at all times. It varies with the temperature and wind velocity, being greatest when the temperature is high and the wind blowing hard. Soil evaporation is also high during such periods. This being the case it is necessary to use great care in handling cultivated land to see that as little as possible of this loss occurs. The demand of the plant for water during critical periods must be met.

The proper cultivation of crops in semiarid regions requires that an evenly distributed earth mulch, at least 3 inches deep, be created and maintained over all the space between the rows during the growing season. This soil mulch and the cultivation to produce it cause the plant to root deeply, and in all respects the effect of the mulch is beneficial. The mulch must be restored after each rain as soon as the ground is dry enough to cultivate. In case of no rain the field should be gone over at least every ten days to insure the maintenance of the mulch. For implements, small buzzard-wing sweeps set so that the dirt falls back in the furrow or spring-tooth cultivators may be used. Leave no open furrows. If the cultivator used has a tendency to leave an open furrow, drag a wheel behind the cultivator in order to fill the furrows and even the mulch. The first cultivation should set the mulch as deep as necessary, 3 or 4 inches, and no later cultivation should go below it. The earth under the mulch soon becomes filled with feeding roots, which must not be injured or disturbed if the best yield is to be obtained. Great care should be taken to see that the mulch is maintained throughout the growing season and at the depth specified. This is most important, especially in dry seasons.

All crops should receive clean and late cultivation.

WINTER COVER CROPS.

Winter cover crops are not recommended for western Texas or western Oklahoma. The controlling factor is moisture. Crops grown in this way usually require so much moisture that there is not a sufficient amount left in the soil to meet the needs of the crop which is to be planted in the spring. Hence, these crops are not to be recommended. In more humid sections where moisture is not the controlling factor winter cover crops are a valuable adjunct in building soil fertility. Humus must be supplied in other ways in semiarid regions generally. It is best done by complete rotations, by alternate-row systems of planting legumes, and by the use of manure.

CROPS TO BE GROWN.

In any territory it is advisable to use the crops adapted to the soil, climate, and other conditions. This is more important in regions of light rainfall than elsewhere. It is a well-established scientific fact that crops thrive best where soil and climatic conditions most nearly approach those of their natural habitat. By an "adapted crop" is meant a crop that is either naturally adapted to the soil and climate of a certain region or has become adapted by having been grown in that section for a number of years. Some plants naturally draw less moisture from the soil than others, while some are naturally provided with a deep rooting system which enables them to thrive in regions of light rainfall. Whatever the scientific reason may be it is noteworthy that certain crops grow and produce better in these regions of light rainfall than others. It is not advisable for farmers to continue raising any crop where under the best practices the yield on account of climatic conditions does not average more than the cost of production, especially where the crop may be readily replaced by a more profitable one. It must be remembered that there are certain soils that are better adapted for certain crops than other soils. In part of the region described in this circular corn can be raised profitably, but it can not be raised profitably on all lands. In part of this section corn is not a profitable crop on any land, year in and year out.

For this region the farmer has the choice of a large number of crops which can be raised profitably, such as corn (where experience shows that the yield is sufficient to pay a profit), kafir, milo, sorghum, cotton, cowpeas, Spanish peanuts, wheat, oats, rye, and emmer or spelt. All of these will be recognized by farmers generally as crops that have "sort o' caught the hang" and are naturally adapted to the soil and climatic conditions of the region in question. No attempt has been made to cover the entire list. Others might be added with profit. These are the standard crops, well known and recognized by all. Many others are being tried out and will eventually be adopted. Every farmer should produce some of them. On every farm where the soil is suitable some wheat, oats, or emmer should be produced. The early harvesting of such small grains enables the farmer to get on the ground early in the season with the disk harrow, in order to save moisture for the next crop, as previously mentioned. Wheat after corn is perhaps the best rotation for wheat. The corn land should be properly cultivated, the crop removed as early as

possible, and the ground disked and harrowed, never plowed. It is seldom of advantage in western Oklahoma and western Texas to follow small grain with cowpeas. Each farmer should have some cowpeas. In the region of light rainfall they can best be used in the alternate-row system. Where experience over a long period of years has shown that it is safe to plant cowpeas after small grain, that practice may be followed, but it should be looked at as an experiment until thoroughly tested for a period of years. Only such practices should be followed as bring the best results under average conditions. Oats should follow cotton, or peanuts if you have them. Where corn can not be produced, the grain feed can be grown from kafir or milo. The sorghums produce an abundant supply of forage. It is well to have some cotton for a money crop, and by the use of alfalfa, peanuts, and grass pastures where possible, and the production of silage to have sufficient feeding stuff for live stock, which ought to be part of the farm system of every dry-land farmer.

PLANTING.

A few simple principles, coupled with the knowledge of planting possessed by farmers generally, will be sufficient here.

As the amount of moisture in the soil is the controlling factor in crop production in the territory in question, great care should be taken to see that the number of plants grown upon a given area is such as to produce the maximum results in crib, bin, or bale yields. Where the rainfall is light greater space between the rows and in the rows, within reasonable bounds, gives greater crop production. There will be found a given amount of moisture in the soil under a certain number of square feet of surface. If this moisture is only sufficient to grow and mature the seed on one healthy plant, the same area can not be expected to mature the seed on two, three, or four plants. The farmer would not expect to fatten two pigs on the bare amount of feed necessary to fatten one. The plant must therefore be given such space between the rows and in the row as experience shows will lead to a maximum production under average conditions. No set rule can be given. Generally speaking, the farmer is inclined to try to grow too many plants on a given number of square feet of surface in all of this territory. For example, it has been found by many farmers that planting alternate rows of cowpeas or peanuts did not materially reduce the yield of corn, kafir, or milo on a given number of acres.

The quantity of seed used per acre should be much less than that required in more humid sections. Good results have been obtained by the use of from one-third to one-half of the amount usually used in more humid sections farther east. Especially is this true in the case of small grains. In planting it is best to use implements which place the seed in the ground in contact with moist soil and repack the soil on top of the seed. If seed is dropped into loose dry soil and nothing is done to bring the soil in close contact with the surface of the seed, the amount of moisture may be and often is insufficient to produce germination, resulting in a poor stand or a failure of the crop. The 2-row disk planter and the lister with the subsoil attachment can be used to good advantage. Where the lister with the sub-

soil attachment is used the subsoiler is made narrow, not to exceed a width of from one-half to three-fourths of an inch. A wide subsoiler prevents the packing of the soil at the side of the seed as readily as a narrow subsoiler.

Aside from the question of getting the seed into moist soil, all planting should be as shallow as possible.

THE CORN CROP.

It is not necessary to go into detail regarding methods of planting and cultivating a crop of corn for this territory. Emphasis should be laid on the fact that corn will not be found a profitable crop in this semiarid region, year in and year out, except on certain rich bottom lands or where experience shows that a paying crop can be produced under average conditions. But the uplands and all land which does not produce paying crops year in and year out should not be planted to corn. Every farmer should have some other grain crop besides corn, such as milo or kafir, in order to make sure of his production of feed. Varieties of corn should always be used that have been found by experience to be best adapted to the region.

Our circular No. "A"–80, entitled "The Corn Crop in the Southern States," goes into detail and can be had upon application.

THE COTTON CROP.

Cotton is more or less of a natural drought-resisting plant and thrives under normal conditions and with good preparation in all of this territory.

The seed bed should be prepared as indicated in the chapter on that subject in this circular. Varieties of cotton should be planted which have been well selected and are adapted to the climatic and soil conditions. Plant as early as is safe from frost; the actual date of planting depends upon the locality. The important point is to plant as early as the weather and soil conditions permit quick germination and growth. Nothing is gained by planting before there is sufficient warmth in the soil for the seed to germinate and the plant to grow off strong and vigorous. Plant early-maturing varieties of cotton that have been well selected. The distance apart of the rows and of the plants in the rows depends upon soil and moisture conditions. As a rule, in semiarid territory the farmer leaves his stand too thick. Cotton needs a well-prepared and well-pulverized but firm seed bed; it will not do to plant upon a loose and poorly prepared seed bed.

Cultivation should be in accordance with the rules already stated.

CROPS OF KAFIR AND MILO.

In all of this territory either kafir or milo, or both, will be found to be the most dependable grain crops for the farmer. Kafir has been found to be the standard grain and feed crop for the uplands all over Oklahoma, except in some localities where milo matures a higher yield of grain. These two crops are known as grain sorghums. Both kafir and milo are strong drought-resisting crops. Kafir is like other sorghums. After it gets well started, the plants will wait for weeks for rain. During severe drought and long hot spells the plants

may wither during the day, but freshen up at night. When there is sufficient moisture again through rainfall, the crop will go on and mature. In case of milo, the habit of the crop is to grow quickly and mature a crop of seed, large or small, depending upon the amount of stored moisture the crop has for its use. In many sections of western Texas milo has given better results than kafir. In the extreme western section of Oklahoma there is a strip where milo has been found more successful when the quantity of grain produced on an acre is considered. Experience and observation will be the best guide in determining which is the better crop for any section. Forage value and ease of harvesting should be considered. Kafir grows with an erect head and is more easily harvested with a wagon-box header or other harvesting method than is the crooknecked milo.

As the seed heats in storage when taken from the head, seed which is to be used in planting should be kept in the head until within a short time before planting. The seed can be easily removed from the head by hand by the use of a currycomb or similar instrument, laying the head on a board and scratching the seed off into a box or tub; or it may be rubbed off on a washboard. The best seed will come off first. The remainder can be used for feed.

Seed selection.—Seed selection is as important in maintaining maximum yields of kafir and milo as with other crops. Seed which has deteriorated from crossing or from natural causes due to the failure of selection brings a low yield as compared with seed which has been well selected and kept pure. The following method was worked out by demonstration agents in the Farmers' Cooperative Demonstration Work in cooperation with other agricultural workers in Oklahoma.

The selection of seed should be done in the field after the crop has matured. In the case of kafir, examine the stalks in the field. Select heads only from stalks of medium height, thick, and short jointed rather than from tall, long-jointed stalks. Examine the head itself next and select only those heads in which the main or center stem extends up into the head to within at least 3 inches of the tip. This stem should be short jointed. If the center stem is long jointed, that is, does not contain a relatively large number of joints, do not select that head. The large number of joints is necessary because the short stems that bear the seed grow in a circle from the main stem at these joints. If the center stem is long jointed or contains few joints, the seed-bearing stems will not be so numerous and will be found longer, giving the head a loose and "sprangly" appearance. Such a head will be found to be lighter than a close-grown, short-jointed, heavy-fruited head.

Then examine the seed-bearing stems themselves, which grow from the joints. They should be short, close together, and the seed should begin near the main stem. Where they are long and the seed begins quite a distance up from the main stem it will be found that the seed is developed on the outside of the stem better than on the inside. On account of the length and the way the seed grows on such a stem it has a tendency to bend outward, which gives the head its loose appearance. Do not select such heads. Good heads should have the seed developed on the inside as well as on the outside of the seed-bearing stem. The seed should be well formed and

thickly set. Examine the butt and note whether it has grown entirely out of the boot, or upper leaf. The best-yielding, heaviest heads will be found to grow in this manner. A poorer yield will be obtained from those which do not grow in this way. The seed stems growing at the butt should be well formed, quite close together, and should not grow straight up along the main stem, but should extend out at a slight angle. Then examine the head for its weight; discard the light heads; select for seed only those that appear heavy.

In the case of milo, watch the field. Mark the stalks that produce the first heads by tying a string about them. If the head develops other desirable qualities this will help to maintain early production. The head should grow completely out of the boot and the fruit branches or spikelets should be short, well set with seed, and the head heavy and well seeded, especially at the butt. Select well-formed stalks in the field, but not at the end of the row.

The general provisions regarding the selection of kafir apply to the selection of milo.

The seed should be tested for germination before planting by placing it on a woolen cloth, dampening it thoroughly, rolling it up, and placing it in a warm place. Examine it in a week and determine the percentage of seed which has germinated. Good seed ought to show a germination of at least 95 per cent. Five pounds of the best seed, or from 7 to 10 pounds of average good seed, are required to plant an acre.

There are several varieties of kafir and milo. Only the dwarf varieties should be used. They draw less on the soil moisture than ordinary varieties. There are two standard varieties of kafir, the red and the black-hulled white. On the market the black-hulled white kafir is almost universally found. It is the best and should be used. The red is generally deemed to be earlier than the black-hulled white variety. In milo there are also the white and the red.

Planting.—The ground should be prepared as in the case of planting corn. Follow the instructions contained in this circular for the preparation of the seed bed. Kafir and milo are generally planted in one of three ways: With the corn planter, lister, or with the grain drill, stopping up all holes except enough to make the rows 3 to 3½ feet apart. In the use of the corn planter and the lister it is necessary to have special plates to fit the size of the seed and adapted to dropping the seed the required distance. Shallow planting in a lister furrow is best. Two or three heads of kafir or milo make about the same quantity of grain as is found on the average ear of corn. On this basis give your kafir or milo such space that two or three stalks occupy the same space that you would give to one stalk of corn to produce a good ear. Often these crops will produce well when planted thicker, but safety is on the side of the thinner seeding when we remember the variations of the season and the shortage and irregularity of the rainfall. During the years of short rainfall many bushels of grain of these crops have been lost because of too thick planting.

Nothing is to be gained by too early planting. These are warm-weather crops and should not be planted until the ground is thoroughly warm. A week or ten days later than corn is not too much.

As a rule, shallow planting is advisable, especially where listed or on soils that easily wash. In any event the grain must be placed in the soil so as to come in contact with moist earth.

Give the plants a distance in the rows and between the rows that will furnish an abundance of room. More crops are hindered by too thick planting than by giving too much space. Many farmers are obtaining excellent results by planting alternate rows of kafir or milo with cowpeas or peanuts. The alternating crops should never be placed between the rows any closer than full-row distance, on account of the moisture necessary to mature the crop. From 3½ to 4½ feet between rows and from 1 foot to 2½ feet in the row, depending upon the condition of the soil and the amount of moisture stored, are proper distances for planting.

Cultivation.—The cultivation should be exactly the same as for corn. It is advisable to cultivate kafir or milo once or twice after the usual time for laying by the corn. In all semiarid sections a soil mulch of at least 3 inches in depth should be maintained over all the space between the rows and carefully renewed and reestablished after every rain or, in the absence of rain, every 10 days during the growing season. This is as important for kafir or milo as for any other crops.

Harvesting.—Kafir is generally harvested in either of two ways: By cutting with the corn binder and shocking or by heading with an ordinary wagon-box header, several types of which are now manufactured. Where the entire stalk is to be cut, a sled cutter is sometimes used. The heads are separated from the stalks after the crop is cured in the shock. The stalk is fed for forage and the seed either thrashed or preserved in the head. It is sometimes thrashed from the shock by holding the heads at the mouth of the thrasher. After the teeth have taken off the grain the bundle is used for fodder. Where the heads have been separated they are run through the thrasher in the ordinary way.

Storing.—Kafir or milo in the head may be stored in any ordinary way so long as the piles and quantities in any bin or granary are not made too large. Where the grain is thrashed it is likely to heat, especially in damp weather. This tendency is more pronounced in spring, about the sprouting season, than at any other time of the year. Seed purchased already thrashed for planting should be carefully cared for by farmers. Spread it out or shovel it over every day or two, to keep it from heating. Grain elevators, where a market for these grains has been established, have generally provided themselves, or should provide themselves, with means for handling these grains.

Feeding value.—One bushel of kafir or milo is worth as a feed for horses, mules, dairy cows, beef cattle, hogs, or sheep nine-tenths of a bushel of corn. That is, 10 bushels of kafir or milo are equal to 9 bushels of corn. Kafir or milo should be given with some other feed in order to obtain the best results. Both are costive in their effect and should be fed with alfalfa hay or oil meal. It will be well to obtain instructions from your State experiment station regarding the feeding values of these grains and the best methods of using them. The use of silos is recommended.

It should be mentioned here that kafir and milo make good poultry feed and on the market the vast majority of the crop is used for preparing mixed poultry feeds.

ROTATION OF CROPS.

The suggestions relative to the alternate-row system for corn, kafir, or milo, and cowpeas or peanuts is really a rotation, as pointed out. If the growth is plowed under it helps to add humus to the soil. No attempt will be made here to go further into this subject, but a separate circular, making suggestions for the rotation of crops for soil improvement, will be issued.

BRADFORD KNAPP,
Special Agent in Charge.

Approved:
WM. A. TAYLOR,
Chief of Bureau.

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